

stock and poultry killed. At Adair, very heavy hail; several buildings unroofed. At Casey, crops destroyed and buildings badly damaged. At Mento, City Hall unroofed, windows broken, farm crops ruined; almost impossible to estimate the damage. Avoca, Pottawattomie county, Iowa, 12th, 5,000 panes of glass broken; buildings otherwise damaged. In surrounding country calves, hogs, chickens and ducks were killed by the enormous hail; cattle and horses were terribly bruised; hail stones size of man's fist. In Auderbon and Cass counties, 12th, hail stones of remarkable size, and blown into drifts two to three feet deep; growing crops almost obliterated. Rockingham county, Va., 25th, near North Mountain, hail fell to a depth of six inches, the stones being of uncommon size, and remaining on the ground for twenty-four hours. Deadwood, Dakota, 6th, during the afternoon hail stones, size of hen's eggs, fell for over two hours; one stone was reported to have measured twenty-one inches in circumference. Cincinnati, Ohio, 13th, hail stones from two to six inches in circumference, and some reported to have been five inches in diameter; twenty minutes after the storm stones were picked up as large as goose eggs. Greenhouses and gardens damaged severely, and many thousand panes of glass broken; severest storm ever experienced. Abilene, Kansas, 9th, continued for about twenty minutes, causing great damage to window glass, trees and garden crops; in country loss to crops very heavy. Beloit, Kansas, 9th, very heavy, breaking window glass and destroying crops. Solomon City, Kansas, 9th, glass in the north windows of nearly all of the houses in the city were broken; hail stones as large as walnuts, and covering the ground to a depth of several inches. Chester, Ill., 2nd, hail stones nearly the size of goose eggs, doing great damage to gardens, trees and windows, and severely injuring persons and stock. Storm continued for fifteen minutes. Clinton, Ill., 2nd, great damage to fruit and growing crops. Storm continued for about ten minutes. Rockbridge, Ill., 2nd, hail stones one and a half inches in diameter; hundreds of acres of wheat completely torn to pieces, and not worth harvesting; fruit very badly damaged. Walnut Grove, Ill., 2nd, over 500 acres of growing wheat and young corn terribly cut up; large amount of window glass broken. White Hall, Ill., 2nd, most violent storm ever experienced; great destruction of wheat, corn, potatoes and fruit; a number of birds, chickens, and rabbits were found killed by the hail; direction of storm path northwest to southeast; length, about seven miles; width, one mile.

RELATIVE HUMIDITY.

The percentage of mean relative humidity for the month ranges as follows: New England, from 64 to 90; Middle Atlantic states, 60 to 82; South Atlantic states, 55 to 83; East Gulf states, 60 to 80; West Gulf states 52 to 72; Ohio valley and Tennessee, 62 to 77; Lower Lake region, 66 to 77; Upper Lake region, 69 to 76; Upper Mississippi valley, 67 to 76; Missouri valley, 66 to 68; Extreme Northwest, 65 to 74; Northern Slope, 57 to 66; Southern Slope, 29 to 57; Rio Grande valley, 52 to 73; Southern Plateau, 18 to 25; Middle Plateau, 13 to 27; Northern Plateau, 37 to 48; North-Pacific coast region, 66 to 73; California, 36 to 77. *High stations* report the following percentages not corrected for altitudes: Pike's Peak, 48; Santa Fé, 20; Cheyenne, 33; Denver, 31; Mt. Washington, 78.

WINDS.

The prevailing winds during the month of June, 1881, at Signal Service stations, are shown on chart No. II by arrows, which fly with the wind. Over the country east of the Mississippi and south of the Ohio, *southwest*. Over the the Lakes, *northerly*. Over the Middle Atlantic states and New England, *variable*. From Texas northward to Manitoba, *southeast* and *south*. Over the Plateau regions, *south* to *west*. Along the Pacific coast, *westerly*.

Total Movements of the Air.—The following are the *largest* total movements at Signal Service stations: Mt. Washington, 18,323 miles; Wilmington, 14,792; Portsmouth, 11,800; Hatteras, 11,420; Pike's Peak, 11,178; Ft. Sill, 10,418; San Francisco, 10,183; Kittyhawk, 9,717; North Platte, 9,450; Stockton, 9,441; Sandusky, 9,425; Chincoteague, 9,414; Delaware Breakwater, 9,344; Dodge City, 9,238; Ft. Elliott, 9,097; Macon, 8,977; Eagle Rock, 8,729; New Shoreham, 8,657; Cape Henry, 8,496; Thatcher's Island, 8,386; Barnegat, 8,260; Champaign, 8,082; Decatur, 8,067; Cape Henry, 8,029. The *smallest* are Lynchburg, 1,198; La Mesilla, 1,511; Phoenix, 1,780; Florence, 1,880; Lewiston, Idaho, 2,256; Duluth, 2,552; Roseburg, 2,687; Silver City, 2,737; Tucson, 2,821; Memphis, 2,829; Nashville, 2,860; Washington, D. C., 2,939; Augusta, 2,947.

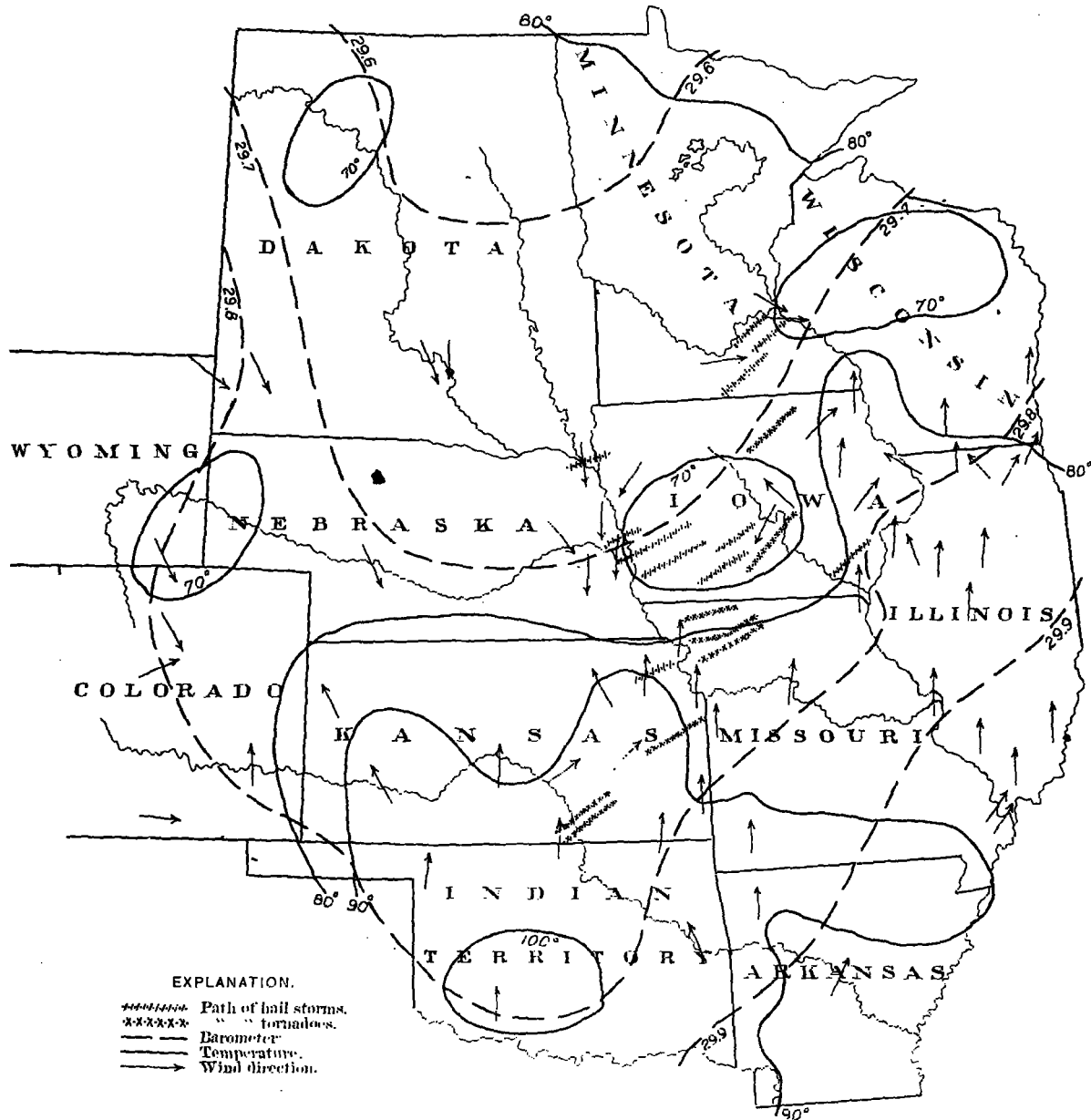
High Winds.—Winds of 50 miles per hour and over were reported as follows: On summit of Mt. Washington, 3d, 5th, 6th, 10th, 14th to 20th, 27th, 29th; maximum velocity, 94 miles NW. 16th. On summit of Pike's Peak, 76, SW. 15th; North Platte, 24th, 25th, 28th; maximum velocity, 60, W. 25th; Ft. Keogh, 60, SW. 5th; Portsmouth, 60, NE. 22d; Sandusky, 57, NW. 29th; Yankton, 56, W. 28th; Dodge City, 56, NW. 25th; Thatcher's Island, 56, NE. 10th; Ft. Buford, 55, NW. 10th; Cape May, 53, W. 8th; Stockton, 52, SE. 28th; Ft. Stevenson, 50, SE. 15th; Delaware Breakwater, 50, NW. 8th; Chincoteague, 50, SW. 29th; Morgantown, 50, W. 29th.

Local Storms.—Storms of this character have not been unusually frequent or severe during the present month, although the loss of life and property has been very great. The most destructive were confined to the region known as the Lower Missouri valley, comprising the western portions

of Missouri and Iowa and the eastern portion of Kansas and Nebraska. Several storms were reported by the newspapers and others as *tornadoes*, but upon examination they proved to be only very severe hail-storms or wind storms of considerable force, the characteristics of a tornado proper not being manifested. The most violent of that class of storms, called tornadoes, occurred on the afternoon of the 12th, and during that portion of the day the peculiar atmospheric conditions which prevailed over the Lower Missouri valley, as indicated upon Map "A" accompanying this REVIEW, are given as follows: The area of low barometer extended from the Upper Lake region southwestward to northern Texas, and thence northward to Manitoba. Along the southeastern edge of this area and northward to parallel 40° the winds were from south to southwest, with temperatures ranging from 80° to 100° . Over Iowa, Nebraska, and extending thence westward into Colorado and Wyoming, a belt of north to northwest winds prevailed, with temperatures ranging from 63° to 78° . Confined to a region of country having a width of about 500 miles a thermal difference of 37° was presented along the line of conflict between the opposing northerly and southerly winds. Bounded by the distinctive features of these atmospheric currents it is found that Kansas, Missouri, Iowa and Nebraska, but more particularly the two former, come within the region of violent wind storms and tornadoes. Andrew Co., Mo., 12th, about 5 p. m., violent tornado formed 8 miles northwest of Savannah and passed in an easterly direction several miles north of the town. Its course continued a little north of east until it reached Flag Springs, when it bore still more to the north, passing over the village of King City, De Kalb Co., after which its course could not be traced from the imperfect data at hand. During its incipient stages the path of destruction was about 160 yards wide, increasing thereafter to about one quarter of a mile. The storm cloud was funnel shaped, with the smaller end toward the earth. At times it would careen from side to side, followed by an upward and downward motion of the body of the cloud, as if drawing itself into a sheath. Along the path of the storm everything was swept clean; the destruction of growing crops could not be estimated. About 80 buildings were demolished and 12 or 15 persons killed. One man was reported to have lost 80 head of cattle, another 250 sheep, and another 6 head of horses; other farmers lost heavily in stock, the losses of this nature being unprecedented. De Kalb Co., Mo., 12th, about 5 p. m., tornado formed several miles to southwest of Winslow and moved thence northeastward passing near that town. Continuing its northeasterly course it reached the village of Berlin, Gentry Co., thereafter disappearing to the northeastward near Grand River. Several persons were killed outright and many seriously injured. The destruction of houses, barns, fences and farming implements was very great. Width of storm path about 200 yards. Nodaway Co., Mo., 12th, between 4 and 5 p. m., tornado formed in vicinity of City Bluffs, near the Nodaway River, and passed northeastward to the west of Hopkins. Several persons were killed and many buildings demolished. Indiana, Pa., 7th, very violent and destructive tornado; cloud funnel shaped, small end toward the ground. Direction of movement southwest to northeast, passing over the most thickly settled portion of Washington, Wayne and Cherryhill townships. Fifteen buildings were destroyed and a large amount of growing timber, fences, crops, &c. At some points the storm was not more than 100 yards wide, and at times would appear to lift from the ground and again descend with redoubled fury. Length of storm path over 15 miles. Loss of property estimated at \$40,000. Osage Co., Kan., 12th, about 4 p. m., tornado formed east of Olivet, near the Marias des Cygnes River, and passed northeastward over the country lying to the South of Salt Creek, and traversing portions of Olivet, Melvern and Agency townships. At Quenemo, near the junction of Salt Creek and the river above named, many buildings were demolished, the debris being scattered for miles. Along the course of the storm cattle were lifted into the air and dashed lifeless to the ground; articles of household goods were smashed into atoms, and bedding and clothing whipped into rags. In some cases people were stripped of their clothing by the force of the wind, and small objects were carried several miles. Five persons were reported killed and over 20 wounded. Over 50 buildings were totally wrecked, and together with the loss to crops, fences and orchards the damage is estimated at \$150,000. Cowley Co., Kan., 12th, about 4 p. m., tornado formed to the southwestward, near the Arkansas River, a few miles below Minnescah, and passed thence northeastward to the town of Floral, on Timber Creek, where it destroyed 28 houses, killed 3 persons and wounded 22. The whole town was nearly wiped out of existence. Where the storm cloud struck the creek the water was sucked up and carried over the adjoining fields in the path of the storm. The leaves on the trees were withered as by the heat of fire, and huge trees were pulled up by the roots or twisted off by the terrible force of the wind. The cloud was in hue a greenish black, with streaks of fire apparently darting through it. Its form was funnel shaped, with the smaller end toward the ground. Its movement was not altogether continuous and regular, but it would gyrate from side to side and then dart forward with renewed energy. After leaving Floral the storm's course was still northeastward, and great destruction to crops, fences and buildings was caused in the neighboring country. Length of storm path over 20 miles, the width varying from a few hundred feet to a quarter of a mile. In many instances the line of destruction would be very closely defined, for on one side of a road the land might be swept clean, while no injury would be done on the other side. This storm is considered the most destructive that ever visited southern Kansas. Belleplaine, Sumner Co., Kan., 12th, about 4 p. m., tornado formed several miles to the southwest, near the Minnescah River. Course of storm path north-

MAP "A,"

Showing the Pressure, Temperature and Wind Direction, at about 3 p.m.,
June 12, 1881, over the territory visited by the violent tornadoes and hail
storms of that date.



eastward, crossing the Arkansas River three miles south of Mulvane Junction. Cloud funnel shaped, with the small end downward, drawing everything inward and upward. During the passage of the cloud hailstones over two inches in diameter fell in large quantities, and a hot southerly wind prevailed, which made it difficult to breath and turned the leaves of corn as black as dirt. Warren Co., Iowa, 12th, about 4 p. m., tornado formed in the northwestern part of the county, some miles southwest of Norwalk, and moving thence northeastward passed over that town, destroying 8 buildings and much other property. Still further northeastward the storm passed near the town of Rising Sun, in Polk Co., where 11 buildings were wrecked and several persons killed. Passing over North River the storm cloud was reported to have sucked up large quantities of water and partially demolished the wagon bridge. A farmer was reported to have lost every hill of corn in 30 acres, it being pulled up by the roots. At Colfax, Jasper Co., in the line of the storm, 7 buildings were destroyed. The course of the storm thereafter continued to the northeast. Hancock Co., Iowa, 12th, about 4 p. m., tornado formed over the central portion of the county and passed northeastward, its first destructive effects being felt at a Bohemian settlement 4 miles west of Garner. Here it destroyed about 15 buildings and seriously injured 9 persons. Over the country to the northeastward everything was destroyed in the path of the storm; buildings, farm machinery and crops were in terrible ruin. Many objects were carried long distances; a clock 2 miles, a lumber wagon 40 rods, a horse 50 yards, &c., &c. Morris and Lyon Cos., Kan., 9th, very violent northwest storm passed southeastward down the valley of the Neosho. At Dunlap, storm struck about 5 p. m., demolishing from 10 to 15 buildings and killing two persons. On Rock Creek, some distance below, 1 person killed and several buildings wrecked. At Council Grove, storm struck about 4:30 p. m. Several buildings unroofed, but more serious damage occurred in the surrounding country. At Americus two large churches were nearly demolished, several small houses and outbuildings blown over, and wind mills, orchards and fences suffered badly. At Plymouth orchards were ruined and outbuildings generally unroofed or blown down. At Emporia storm struck about 7 p. m., and proved to be the most violent since the very destructive storm of 1878. The western portion of the town suffered most severely, although the damage was considerable in other portions. About 25 buildings were blown down or unroofed and many other minor damages committed. The heaviest wind, accompanied by a deluge of rain, continued with some variability for about an hour and a half, although a very brisk wind prevailed all night. At Neosho Rapids still further southeastward, and near the county line, no material damage was done, the storm having apparently lost considerable of its energy before reaching this point, or shifted its course further to the south. Mitchell, Ottawa and Dickinson counties, Kansas, 9th, between 5 and 6 p. m., very violent northwest storm, accompanied by heavy rain and hail, passed southeastward down the Solomon valley. Fifteen or twenty buildings were demolished along the river, between Beloit and Solomon City, and very serious damage to crops by the hail and rain. Five persons were reported killed. Storm continued for about one hour. Blue Earth City, Faribault Co., Minn., 12th, about 4 p. m., most violent wind storm that ever visited this section. Five inches of rain fell in 1 hour, and 10 or 12 buildings were demolished, but the damage to crops was not very great. After leaving this point the storm passed northeastward, visiting the town of Luria, in the northern part of the county, where 7 buildings were wrecked and 2 persons killed. Northfield, Rice Co., Minn., 12th, about 5 p. m., most furious wind and rain storm ever experienced; estimated wind velocity, 75 miles per hour; in 13 minutes 2.00 inches of water fell. Trees were uprooted, sidewalks and fences carried away, and several buildings blown down or unroofed. Shakopee, Scott Co., Minn., 12th, about 7 p. m., furious wind and rain storm; several buildings unroofed, trees uprooted and fences carried away; damage to crops in surrounding country very great. Eureka, Nev., 3rd, 4 a. m., terrific wind storm, continuing unabated for 12 hours, when it died out suddenly. Nothing like it ever before experienced. Dust and gravel filled the air continually, and completely stopped business; fences blown down, trees uprooted and buildings unroofed. The wind came from the south without a variance; weather warm, sky perfectly clear, not a cloud visible. Deadwood, Dak., 6th, p. m., whirlwind struck Deadwood gulch, near the junction with Whitewood gulch, completely destroying 4 buildings and killing 2 persons. Hundreds of trees were uprooted, and thrown in some instances 500 feet. Telegraph poles were torn up for several miles, and everything in the path of the storm was carried away. The storm divided and disappeared before reaching the thickly settled portion of the town. Pittsburg, Pa., 29th, about noon, violent northwest storm of wind and rain passed over the hill district, including the 13th and 14th Wards. Trees uprooted, fences carried away, and several houses and out buildings blown down. Storm lasted about 40 minutes. Delaware Co., Pa., 29th, violent northwest storm in northern part of county; several buildings unroofed, trees uprooted, and hundreds of acres of grain laid waste. Width of storm path about 1 mile; storm continued for 1 hour. Port Republic, Va., 25th, violent wind storm from the southwest; width of path about a mile and a half; length, 6 miles. Many buildings unroofed and blown over, and hundreds of acres of wheat, corn and garden crops entirely destroyed. A large amount of valuable timber was ruined. Mill Creek, Iowa, 28th, grist mill demolished, and several other buildings unroofed. Fonda, Pocahontas Co., Iowa, 25th, several buildings blown down. Merrill, Plymouth Co., Iowa, 25th, passenger train on side track overturned by the wind; several buildings unroofed. Alexandria, Ind., 12th, violent wind storm; fences and chimneys blown down, and several buildings unroofed. Queen's Peak, Montague Co., Texas, 12th, houses and fences blown down and trees uprooted; crops badly damaged.

Wakeman, Ohio, 16th, most violent storm ever experienced in this section; buildings torn to pieces or unroofed, orchards and forest trees uprooted, fences scattered and crops destroyed. Cherokee Co., Iowa, 28th, about 4 p. m., tornado from the southwest passed over the town of Cherokee, demolishing several buildings and killing three persons. From this point the storm passed northeastward over portions of Buena Vista, Clay and Palo Alto counties. The destruction was mostly confined to the country, where the loss to farmers was very great. Calhoun Co., Iowa, 30th, about 5 p. m., tornado formed southwest of the town of Manson, and moving northeastward, visited that place, where nearly every house was destroyed and several persons killed. The storm continued its course northeastward through the northwestern portion of Webster Co. and the southeastern portion of Humboldt Co., in both of which the destruction of buildings, crops, fences and farm machinery was very great. Anna, Ill., 2d, 4 miles west of station, heaviest wind storm that has visited this section for years; barns and sheds were blown to pieces, trees stripped of their foliage, and many of the larger ones twisted in two. Boonville, Mo., 7th, very violent, much damage to crops and fences, and several buildings blown down. Tuscola, Ill., 5th, 8 miles north of station, very violent wind storm, causing great damage to fruit trees, crops, buildings and fences. Nokomis, Ill., 29th, 5 p. m., most terrific for years; trees, buildings and fences blown down; farm crops suffered severely; at Shelbyville a heavy freight train was brought to a stand, and could not be moved until storm abated. North Platte, 25th, 5.40 p. m., wind backed to northwest and west and blew a hurricane, with gusts of 90 miles per hour; path of destruction commenced about 10 miles west of station, and pursued a course nearly due east for a distance of about 140 miles. Several wind mills and buildings were blown down before reaching the city, which the storm traversed in the northern part, demolishing the round house of the Union Pacific Railroad Company, killing 1 person and wounding 2 others; one portion of the building was carried to the northeast, and the other to the northwest. Heavy masses, in some instances weighing ten tons, were carried a distance of 200 feet. Storm appeared to follow the Platte river. Washington, D. C., 27th, about 8 p. m., heavy northwest storm; large number of buildings unroofed and partially blown down; shade trees uprooted and fences prostrated; loss estimated at about \$140,000. Course of storm NW. to SE.; no damage committed outside of city limits.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-weekly indications for June, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 86.75 per cent. The percentages for the four elements are: Weather, 88.2; Direction of the Wind, 80.1; Temperature, 87.6; Barometer, 81.7 per cent. By geographical districts they are: For New England, 86.3; Middle states, 87.1; South Atlantic states, 88.3; Eastern Gulf states, 89.3; Western Gulf states, 95.1; Lower Lake region, 85.8; Upper Lake region, 84.3; Tennessee and the Ohio valley, 87.7; Upper Mississippi valley, 85.0; Lower Missouri valley, 77.4; Northern Pacific coast region, 75.0; Central Pacific coast region, 90.9; Southern Pacific coast region, 100.0. There were 180 omissions to predict (60 being due to the absence of reports from the Pacific coast), out of 3,690, or 4.88 per cent. Of the 3,510 predictions that have been made, 125, or 3.56 per cent., are considered to have entirely failed; 101, or 2.88 per cent., were one-fourth verified; 389, or 11.08 per cent., were one-half verified; 277, or 7.89 per cent., were three-fourths verified; and 2,618, or 74.59 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

Cautionary Signals.—Eighty-one Cautionary Signals were displayed during the month, of which 63, or 77.77 per cent., were fully justified by winds of 25 miles per hour, or over at, or within a radius of 100 miles of the station. No Off-Shore Signals were displayed. The above does not include signals ordered at display stations where the velocity is only estimated; 122 winds, of 25 miles or over, were reported, for which no signals were ordered; 14 signals were ordered late.

NAVIGATION.

Stage of Water in Rivers.—In the table on the right hand side of chart No. III are given the highest and lowest stages of water, as observed on the Signal Service river gauges during the month of June, 1881. In the Red, Arkansas and Savannah rivers the highest stage was reached on the 1st, and the lowest between the 23d and 30th. The highest stage in the Missouri river was reached between the 15th and 16th; in the Mississippi with considerable irregularity, but generally between the 15th and 24th; at Keokuk the water reached within 13 inches of the danger line on the 21st; at Vicksburg within 16 inches on the 1st, and New Orleans within 4 inches on the same date. In the Ohio, highest stage between the 10th and 16th, the water rising 85 inches above the danger line at Pittsburg. In the Cumberland, Tennessee and Monongahela the highest stage was reached between the 5th and 13th. The Willamette, at Portland, Or., reached its highest stage on the 16th.

Floods, due to unusually heavy rains, were particularly destructive throughout the western portion of Pennsylvania, and extending thence down the Ohio affected in a less degree the bordering states. *Arkansas:* Little Rock, 9th, lower portion of city flooded; sewers bursted, causing great damage. *District of Columbia:* Washington, 27th, 2.34 inches of rain fell in 38 minutes, flooding cellars and basement stores, and injuring sewers. *Indiana:* Seymour, 8th, most violent and heavy rain-storm ever experienced in this section; railroad tracks washed away and all travel closed; many houses flooded and business partially suspended. *Illinois:*